THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[FOURTH SERIES.]

No. 80. AUGUST 1874.

XIII.—*On the Nature of the Seed-like Body of* Spongilla; *on the Origin or Mother Cell of the Spicule; and on the Presence of Spermatozoa in the* SPONGIDA. By H. J. CARTER, F.R.S. &c.

[Plate X.]

EVER since 1849, when my figure of the development of *Spongilla* from the seed-like body was published ('Annals,' September 1849, vol. iv. pl. iv. fig. 2), I have been uncertain of the real nature of this body; but lately, as I have been studying the living *Grantia compressa* in its oviparous state, light has been thrown on its nature which seems to show its real import.

By reference to the 'Annals' (*l. c.* pl. iii. fig. 6), it will be observed that the seed-like body is composed of a horny globular case with a hiliform opening, the cavity of which case is filled with spherical transparent cells, each of which again is charged with a great number of minute capsular granules that I have termed "ovules."

As the contents of the seed-like body grow out into the water from the hiliform opening, each spherical cell takes up its place in the "intercellular substance" or sarcodal mass, which appears at the same time to form the body of the young *Spongilla*; and all the "ovules" respectively become developed into monociliated and unciliated, polymorphic, monad-like organisms, which, in their aggregation, form a pavement layer around the spherical cell. This is well shown in the figure to which I have first alluded.

Again, if the so-called ovules be forcibly pressed out into the water from the spherical cell, they will also there, in their isolated state, become monociliated and unciliated polymorphic organisms respectively.

Lastly, if the young *Spongilla* which grows out from the hiliform opening of the seed-like body be fed with carmine or indigo, these monad-like organisms will be still more evidently seen aggregated, in the midst of the intercellular substance, into the form which I have called the "ampullaceous sac." I have also lately termed the monad-like organisms "spongozoa," as their peculiar form &c. seem to demand this distinction.

Let us now consider what the "ampullaceous sac" is.

In 1827, Prof. R. E. Grant (my kind friend and former teacher), with exceeding truthfulness and great ability, described the "ova" of the marine siliceous sponges (Edinb. Phil. Journ. vol. xiii. & Edinb. New Phil. Journ. vol. ii.) as ovoid bodies covered with cilia, which, after issuing from the sponge, sought a place to settle down upon and become developed into a miniature form of the parent.

In 1856, Lieberkühn discovered and figured the same kind of body in *Spongilla*, to which he applied the name of "Schwärmspore" (Müller's Archiv f. Anat., Phys. &c. Heft iv. pl. xv. figs. 35–39).

In 1872, Häckel did this also, with his usual ability, in the Calcisponges ('Die Kalkschwämme,' 1873, Text & Atlas)—proposing the terms "*Planula* or Flimmerlarve" for the advanced state of the ovum, and "*Gastrula*" for that of the following embryonal form—that is, where the internal cavity is formed but does not communicate with the exterior, and where it does, respectively.

Moreover Häckel, in several places, rightly figures the *Gastrula* as consisting of an *ectoderm* or crust of monociliated cells, radiating round the *endoderm*, which again is a layer of much larger and unciliated cells lining the internal cavity in juxtaposition (but not in radiation), and extending out over the aperture of the *Gastrula* in a botryoidal form; thus the convexities of the latter are of course much larger than those of the mulberry surface formed on the exterior by the ends of the monociliated cells of the *ectoderm*. Häckel's illustrations can hardly be too highly praised.

Searching after these ova lately in the marine sponges, I have as yet, from the examination of several gatherings, only found them, in the stages of development just mentioned, in *Grantia compressa* (*Sycandra compressa*, H.); that is to say, the rest of the sponges have either passed through this oviparous state, are coming to it, or, if in it here and there now, the specimens I have obtained (which have been very numerous) do not any of them present it; while its occurrence in every specimen of *Grantia compressa* already becoming effete under the circumstances, seems to point out that, like the inflorescence of plants, this state in sponges also occurs and goes at certain periods, and its elements are in vain sought for before or after these periods in any individual of the same species.

Having now become acquainted with the ovum of the marine sponges, and its development from the egg-like form to the embryo (for it is probable that in all it is more or less alike), it appears to me evident that each spherical cell of the seed-like body is also a distinct ovum; but its development from the seed-like body in the midst of the intercellular substance, where it has to remain, somewhat differs from that of its comparatively isolated condition in the marine sponges, where it has to seek an object for itself to settle down and grow upon.

Thus in the former it requires no crust of *ectodermal* monociliated cells for locomotion, nor does it require the *endodermal* cells for further increase; but the ovum and its capsular granules at once pass into a pavement of monociliated spongozoa, which arrange themselves in the form of the ampullaceous sac, in the midst of the intercellular substance (see figure in the 'Annals,' to which I have first referred). As this is going on, the pores and the branched excretory canal-system are formed, which become respectively connected with the two apertures of the ampullaceous sac. But whether this takes places synchronously, or the cavities of the ampullaceous sacs respectively push themselves through the intercellular sarcode, and, as regards the latter, like streams of water, at last all join together in one common excretory canal, is unknown to me. (For the further development of the young *Spongilla* from the seed-like body see my paper entitled "Ultimate Structure of *Spongilla*," 'Annals,' 1857, ser. 2. vol. xx. p. 21, pl. 1.)

Viewing the seed-like body, then, as a capsule filled with ova, which issue from its hiliform opening and thus become developed *en masse* into the young *Spongilla*, it may be a question whether the entire body may not be the ovarium of a spongozoon in the first place, while, as in hundreds of instances of the same kind in the animal kingdom, all the other parts have perished, their functions having ended when sufficient nutriment had been gathered and assimilated to support the reproductive elements until they could do this for themselves.

But, although this "question" of the origin of the seed-like body remains to be answered, the *object* of the process seems to derive explanation from the fact that the freshwater sponges are, from their habitat, exposed to variable periods of long dryness, from the subsidence of the water in which they dwell; while the marine sponges, in which the absence of a seed-like body is as constant as its presence in the freshwater sponges, not only in many instances are never uncovered, but under no circumstances can be long so, by the sea.

In Bombay most of the freshwater sponges grow many feet above the bottom of the tanks, probably for the sake of purity; so that as the water is withdrawn for domestic purposes, they are soon left dry, in horizontal lines which they occupy along the sides. Under these circumstances, most of them are uncovered by water for six months at least during the year; while their increase is so rapid that herbaceous plants which spring up just below the water's edge in the month of July, may have pieces of *Spongilla Carteri* about them, two or three inches in diameter, by the time the water again begins to recede from these plants in the following October and November.

At last, then, the true nature of the seed-like body of the freshwater sponges appears to be thus revealed. It is an assemblage of ova, which are at once developed together into a young *Spongilla*; and hence my statement in the last volume of the 'Annals' (p. 436), that the ampullaceous sac is Häckel's *Gastrula* developed *in situ*.

On the Origin or Mother Cell of the Spicule in the Spongida.

In August 1856, Lieberkühn published, as one of the results of his study of *Spongilla*, that the spicule originates in the interior of a cell, "die Kieselnadeln entstehen innerhalb der Zellen," which had been illustrated in the preceding "Heft" (Müller's Archiv f. Anat. Phys. &c. Hefts iv. & v. p. 513, and Tab. xv. fig. 22, respectively). In this figure the spicule may be observed to be enclosed by a cell bearing a distinct nucleus and granules.

In the following April (1857), my paper on the "Ultimate Structure of *Spongilla*" was presented to the Bombay branch of the Royal Asiatic Society (B. B. A S. Journ. vol. v. p. 574), and reprinted with illustrations in England ('Annals,' July 1857, ser. 2. vol. xx. p. 21, pl. 1), where in fig. 8 will be found an almost fac-simile of Lieberkühn's representation, with the exception that in the former the spicule appears to have been smaller. That there should be such a close resemblance between our figures is not extraordinary, because we were studying the same organism with a similar purpose, about the same time, although one of us was at Berlin and the other at Bombay, thus working independently of each other.

The result of my observations may be found in the paper to which I have alluded; and at p. 23 ('Annals,' *l. c.*), on the development of the spicule, I have thus expressed myself:—

"At the earliest period that a spicule becomes visible it appears under a hair-like form of immeasurable thinness, and enclosed in a sponge-cell of a spindle-shape, which has assumed this figure to accommodate it. The nucleus of the cell is now seen in its centre, and the spicule, about 1-400th of an inch in length, lying across it (fig. 8, *a'*), &c."

It will be seen by the form of the figures that both Lieberkühn's and my own observations had reference to the *skeleton*-spicules, viz. those spicules which are essentially connected with the horny fibre of the sponge, in contradistinction to those minuter forms which are essentially connected with the sarcode, for which I have lately proposed the name of "*flesh*-spicules."

Let us now see how far later observations have confirmed these views in the latter.

In a copy of a report on the siliceous sponges of the North Sea collected during the German expedition of 1871, kindly forwarded to me by the author (Dr. O. Schmidt) in July 1873, my attention is directed to a part where he states that the anchorates and bihamates of an *Esperia* were observed to originate in genuine cells. "An einer bei Arendal vorkommenden *Esperia* habe ich nun die sehr interessante Entdeckung gemacht, das sowohl die Spangen als die Haken aus einem Verkieselungsprocess von Zellmembranen oder wenigstens der membranähnlichen Oberflächenschicht von echten Zellen hervorgehen, &c." (p. 431).

This I have just now been able to confirm in *Halichondria ægagropila*, Johnston (Brit. Sponges, p. 119, and type specimen in Johnstonian collection, British Museum), the common *Esperia* here (Budleigh-Salterton, Devon). It is desirable, however, before going further, to give the diagnosis of what I have arranged in the British Museum under the head of "Esperiadæ." Briefly this consists in the presence of one kind of skeleton-spicule *only*, and an anchorate which is *generally inequi*-ended (Pl. X. fig. 12, *a*, *b*); while Schmidt would almost as strictly confine his "Desmacidinæ" to the presence of the tricurvate (Bogen). Still, how far groups or species of sponges may be determined by the "flesh-spicule" remains to be seen, since in many, otherwise widely different, I have observed the same form of flesh-spicule, almost, too, as if the latter prevailed in certain localities.

But to return to our subject: the specimen of *Esperia* to which I have alluded was charged with four kinds of cells, to each of which separately it is necessary to direct attention, viz.:—

1st. A spherical, transparent, empty one, about 10-6000ths of an inch in diameter, bearing a granular lenticular nucleus in the periphery about 1-6000th of an inch in diameter, from which occasionally might be seen very delicate branched lines of sarcode streaming over the inner aspect (Plate X. fig. 1).

This kind of cell was very numerous, and, shortly after the fragment of *Esperia* had been torn to pieces for microscopic examination, was observed to congregate more or less here and there together, and become united with the neighbouring granules and polymorphic bodies of the sponge into separate agglomerations, well represented by Schmidt in his figure of the like from *Esperia Contarenii* (Adriatic Sponges, Histologie, 1864, 1st Suppl. Taf. i. fig. 5). It was observed too that there were many lenticular bodies about the field, composed entirely of granules without visible nucleus (fig. 2), almost identical with the nucleus of the large empty transparent cell; while the addition of alcohol caused the latter so to collapse round its nucleus, that this also then presented the same appearance: hence it became evident that the large, empty, spherical cell was derived from a plastic layer united to the circumference of the lenticular nucleus, but otherwise capable of being separated from its inner side by aqueous distention into the globular form mentioned.

2nd. A cell bearing the *inequi*anchorate of *Esperia* in different stages of development, from 2 to 5 6000ths of an inch long. This, from the generally elliptical form of the spicule, assumed by contraction a similar shape, and thus, through its living plasticity, often became so closely wrapt round its contents as to leave hardly any thing visible beyond the nucleus and granular plasma of which the cell was composed (figs. 13–16).

Here it is desirable to state that, in its early development, viz. when the cell is perfectly elliptical and about 2 6000ths of an inch long, the embryo spicule appears in the form of an *equi*anchorate (fig. 13), and does not pass into the *inequi*-anchorate form until it has got beyond this size, when the inequianchorate end appears to proceed and the other to be arrested in its development (fig. 16). This to me is a matter of interest, inasmuch as I have made the presence of minute *equi*anchorates, in addition to the others, in some specimens of *Esperia* a point of distinction; while it would now appear that they are merely the early stage of the *inequi*anchorate, and therefore so far valueless. Indeed I am quite convinced that great confusion will arise from this point having hitherto been so neglected, that, in many instances, sponges have been stated to contain, as distinctive characters, spicules which, although widely differing in form and size from, are nevertheless the early stages only of the fully developed ones.

So preeminently living is the sarcode-cell about the anchorates, that in getting them in particular to turn over, it is frequently necessary to use considerable force to detach them from the surface of the glass (fig. 15).

3rd. A similar cell, about 7 by 4 6000ths of an inch in diameter, stretched over a single bihamate like parchment over a drum. Here the cell, being prevented from contracting beyond the confines of the spicule, retains the transparency of its wall, in which the granular, lenticular nucleus is perfectly visible (fig. 11).

4th. A similar cell (differing according to its developmental size), from 2 to 10 6000ths of an inch long, stretched over a variable plurality of tricurvates. Here, too, the cell being prevented from collapsing by the plurality of the spicule, and its often lying crosswise (fig. 7), the transparency of the wall remains, making the granular cytoblast or nucleus more visible (figs. 5–9).

Thus it would appear that all these cells are connected with the production of the "flesh-spicules," and that therefore, with the foregoing observations by Lieberkühn, Schmidt, and myself, it may now be considered settled that the spicule does originate in the interior of a cell.

After the spicules have grown beyond the power of their cells to contain them, the latter, which are still living, would appear to allow them to pass through their parietes, without rupture in the manner of sarcode-cells generally. What becomes of these cells afterwards I know not; but the number of empty cells of the kind first described, with which the *Esperia* may be charged, seems to point out that *they* have either thrown off their spicules, have never had any, or are going to produce more, or never will produce any.

Clear, however, as it now is that the spicule originates in a cell, the *immediate* origin is not known. That they all commence from a minute cell *within* the parent one seems to derive confirmation from the fact that they grow by the extension of the central canal (in the *flesh-* as well as in the *skeleton*-spicule), on which the substance of the spicule is deposited in concentric and therefore successive layers, which central canal probably commenced in a single point or cell. Indeed this is proved by the occurrence in some sponges of globular or ellipsoidal monstrosities, where the natural form of the spicule is exclusively long and linear.

From what part of the mother cell this minute cell or point comes, can hardly be conjectured. All that can be now said on this point is, that the nucleus or cytoblast appears to be entirely composed of a granular plasma, in which the granules are of a uniform size and may afford the first points or cells for the development of the spicules; or this may be furnished by the granular plasma of which the cell-wall itself is composed.

On the other hand, the final development and finishing of the spicule must take place in the intercellular substance or basal sarcode of the sponge; for when even moderately developed, there is not a *single* sponge-cell large enough to contain the spicule. Therefore, however clear it may be that the spicule originates within a cell, that all-important intercellular substance the basal, so-called "structureless," sarcode must be viewed as the agent or "contractor" for the finishing of the spicule as well as for the development of the whole structure.

I had often noticed, in my mounted specimens of *Tethya lyncurium* (*Donatia*, Gray), that the minute stellates were in a vacuole of the dried sarcode, and therefore concluded that each must be formed in its proper cell. But, as Schmidt has stated, the sponge must be *fresh* for the *cells themselves* to be seen; and the fresher it is, and the quicker viewed with the microscope after the fragment for observation has been torn to pieces, the better; for the contraction of the living sarcode goes on so quickly that after a little, especially as regards the anchorates, the cell becomes so tightly wrapt round its contents that it is hardly distinguishable.

Again, I had often noticed that among the sheaf-shaped bundles of minute linear spicules, which exist in many sponges of different kinds, there seemed to be a passing of them into the form of a tricurvate; and when I saw Kölliker's figure of *conjectured* spermatic filaments in *Esperia* ('Icones Histologicæ,' Feinere Bau, 1864, pl. vii. f. 11), represented within a nucleated cell, I also saw at once that these were spicules, and concluded that the tricurvates were produced in like manner. Now this is confirmed.

As I have only found two examples of the occurrence of the bihamate in its mother cell, and in each instance it was single, I am not able to say that it also may not, in some cases, be produced, like the tricurvates, in greater or less plurality. We also know that the inequianchorates in *Esperia* often abound in the form of "rosettes"—that is, where a great number of them with their small ends inwards radiate thus in all directions from a common centre. Here, I think, we must also conclude that the whole bunch is produced in one cell; but I have not yet seen an instance of it. If developed from the granules of the nucleus, the whole of this body of the latter might thus pass into one of these "rosettes." In one cell I observed two *inequi*anchorates together end to end, or slightly overlapping each other; but this was in the *equi*anchorate stage—that is, when neither of these embryo spicules exceeded 2-6000ths of an inch in length (fig. 14).

In order that the full size of the flesh-spicules of *Esperia œgagropila*, C. (*Halichondria œgagropila*, Johnston), might be compared with the embryonic ones in their mother cells respectively, figures of the inequianchorate (fig. 12, *a*, *b*), bihamate (fig. 10), and tricurvate (fig. 3) of Bowerbank (*Haken*, *Spangen*, and *Bogen* of Schmidt) have been represented on the *same scale* among the illustrations.

On the Presence of Spermatozoa in the Spongida.

In January 1856, Lieberkühn observed, with reference to my figures conjecturally termed "zoosperms in *Spongilla*" ('Annals,' Nov. 1854, vol. xiv. pl. xi.), that they were not so, but those of "*Trachelius trichophorus*" (Müller's Archiv f. Anat., Phys. &c. p. 18); and, so far as the negative goes, I believe he was right.

But in August 1856, two years after the "zoosperms in *Spongilla*" appeared, I also published a figure of a minute monociliated sponge-cell attached to a much larger unciliated one, with the following explanation in the index to the plates, viz. "Fig. 43. Small sponge-cell with so-called 'zoosperm' attached, &c." (Annals, vol. xviii. p. 245, pl. vi.), and in the figures close to it, viz. 45 to 48, four representations of *Astasia limpida* = *Trachelius trichophorus*, Ehr., with anatomical detail.

Now, without reference to the identity here of the smaller monociliated sponge-cell with a spermatozoon of *Spongilla*, I would submit to the reader whether (on comparing all these figures, which are within an inch of each other in the same plate) it is likely, as implied by Lieberkühn (*l. c.*), that I could have mistaken a sponge-cell for a *Trachelius trichophorus*, especially as I allude, in the text of my paper on the supposed "zoosperms in *Spongilla*," to the cilium as the "tail"—seeing that the sponge-cell is propelled by the cilium from *behind*, and *Trachelius trichophorus* drawn on by the cilium *in front*, as shown respectively in the figures to which I have just alluded.

With the explanation of this little difference, which may also tend to show the distinction between a monociliated sponge-cell and *Trachelius trichophorus*, let us return to the more valid object of the communication, viz. the developmental discovery, as it may be termed, of the spermatozoa in sponges.

In January, also of 1856 (p. 18, *op. cit.*), Lieberkühn announced his discovery of the spermatozoa in *Spongilla*, which he states, at the conclusion of the article, to have been previously observed by his respected teacher Johannes Müller; and in August of the same year their development is described, accompanied by figures of them separately and within the mother cell (p. 500, pl. xviii. figs. 10 & 15–17, *op. cit.*). They are here represented as minute conical bodies, of which the pointed end is prolonged into a single cilium, but are unaccompanied by any measurement.

From this period up to 1870 I am not aware that any additional information on the subject was communicated, when, in the October of that year, I published the following account of some spermatic-looking monociliated cells which I found in *Microciona atrosanguinea*, Bk. (Annals, vol. vi. p. 339):—

"This monociliated body, which may now [July 30th] be seen in great plurality, with every portion of the *Microciona* torn to pieces for microscopical observation, consists of a rounded triangular head and long cilium [Pl. X. figs 17, 18, & 20]. The head is pyriform or shaped like a Florence flask with the neck drawn out to a sharp point or beak, and the cilium attached to the large end, close to which there appears to be a single granule or nucleus; but in other respects the head is transparent. At first these bodies are in contact with the glass cover, but soon sink to the plane of the slide, about which they move with the head foremost, apparently urged on in a zigzag course by the undulations of the cilium behind. For the most part they are single; but occasional groups of four [fig. 19] are seen rolling over the field after the manner of monociliated cells or spermatozoa which want to become separated from each other. When measured, the head, including the beak, was found to be 1-3000th of an inch long by about 1-12000th broad at the large end, and the cilium seven times as long as the body, or about 1-400th inch long. Under the action of iodine, the head became amber-coloured. While portions of *Microciona atrosanguinea* taken from different localities abounded with this body, together with a number of scarlet gemmules [ova?], in addition to the ampullaceous sacs and monociliated cells of the rest of the sponge, portions of other sponges, even on the same piece of rock, failed to present a similar body when torn to pieces under the microscope. Could this monociliated body with triangular head have been the spermatozoon of *Microciona*?"

This description was unaccompanied by the figured representations which I have now added (Pl. X. figs. 17 to 20), as there was no plate to the paper; and it was not until I saw the illustrations of Dr. T. Eimer (Schultze's Archiv f. mikroskop. Anat., Band viii. Heft 2, p. 281, 1872) that my attention was again called to the subject, when I recognized in his figures almost fac-similes of my own.

In the months of March to July 1871, Dr. Eimer discovered, both in the siliceous and calcareous sponges, on the shores of the island of Capri, similar bodies to those which I have described and have *now* for the first time figured, as may be learnt from his descriptions and those he has illustrated from the Calcispongiæ (*op. et loc. cit.*).

Häckel did the same at the island of Lesina in the Adriatic about the same time, viz. in the month of April (Jenaische Zeitschr. f. Med. und Naturw., Bd. vi. 1871, p. 644 *ap.* H). But he went further; that is, he not only saw the spermatozoa of certain Calcispongiæ in their mother cells *in situ*, but actually saw them entering the ovum of *Grantia ciliata*, Bk. (*Sycortis quadrangulata*, H.) (Die Kalkschwämme, Atlas, Taf. 48. figs. 6, 7, & 8, and vol. i. p. 396). Thus the fact of spermatoid development and impregnation in the sponges was so far established.

The shape of the head of the spermatozoon in Häckel's illustrations differs; for while in most instances it is globular or conical, with the pointed end prolonged into a cilium (like that in *Spongilla* figured by Lieberkühn), it is elliptical accuminated in *Grantia ciliata*, Bk., where the anterior end is extended into a kind of beak; but in no instances does it resemble that of the bodies figured by Eimer or those described by myself in *Microciona* and *now* published. Still, as every living part of the sponge that is soft is subject to polymorphism, no great stress is to be laid upon this difference.

Taking advantage of Häckel's work on the Calcisponges already mentioned, which is a *sine quâ non* to their study, I sought among our calcareous sponges here for those which might be in an oviparous condition, what in plants we should term in a state of "fructification;" but it so happens that there is only one here in this state now, viz. *Grantia compressa* (*Sycandra compressa*, H.); and it also so happens that there are no illustrations of the generative elements of this species in Häckel's work.

Nevertheless, as this is the commonest and hardiest form here, growing on seaweeds in pools easily got at at every fall of the tide, and well known to me to go through its reproductive functions in the months of March, April, and May, so as to become effete and disappear for the most part in June (eaten both inside and out by small Crustaceans), it has afforded me abundance of opportunities of witnessing what Häckel has so truthfully and lucidly described and illustrated of several other species in his work.

Yet in only one instance have I been able to see what appeared to me to be the spermatozoa of the species, and then not living but scattered dead about the field in considerable number (fig. 21).

These bodies, comparing small things to great, were shaped like a sky-rocket, with a long cilium (figs. 22 & 23); the head conical and based on the body, which was somewhat constricted at the point of union, and slightly increasing backwards to an obtuse end, from which projected the cilium. The head and body together measured 1-6000th of an inch long, by about 1-24000th of an inch thick; and being divided into three parts, the body appeared to be just twice as long as the head. The cilium was 10-6000ths of an inch long.

Had these bodies been active and living instead of still and dead, I probably, from their minuteness, should not have been able to obtain the measurements; but, as it was, these with the form were too plain to be mistaken, although the general opacity of the body obscured all differentiation in *its* composition.

That they were not the disintegrated ectodermal cells of the embryo (*Planula* or *Gastrula*), the attachment of the cilium to the *longer* portion (that is, the body) instead of to the shorter one or head (according to Häckel's figures of these cells), seems to point out; besides, the latter was conical and pointed, not obtuse and round like the outer or monociliated end of the *ectodermal* cell. Again, they could not have been dead long, or they would have vanished by "diffluence;" while the adhesive sarcodal composition of the ectodermal cells seems to defy any separation of them into individuality, although I often tried to produce it.

Of course I can only state and show what these bodies were; for although they may look very much like spermatozoa, yet, seeing them enter the ovum is the only proof that they are such and do belong to the sponge.

I have also observed another monociliated body in a fresh specimen of *Halisarca Dujardinii*, equally pregnant with ova as the *Grantia compressa*, but not so far advanced (figs. 24 & 26, *a–i*). It was circular in form, like a coin with a rounded thick obtuse edge, diminishing to extreme thinness towards the centre, where there appeared to be a *single* granule, the rest of the body being homogeneous. From some part, whether towards the centre or at the circumference I could not determine, projected a single cilium. The body while in activity exhibited a subpolymorphic form and often became cup-shaped or conical towards the middle on one side (fig. 26, *g*); while the rim as often became thicker and seemed to hold the granule just opposite the cilium, giving the translucent centre a kind of horseshoe-shape (fig. 26, *e*).

The cilium propelled the body forwards, but as often too presented a bulbous soft swelling at the end, which seemed to act as a sucker in anchoring the body to other cells and sarcodal objects in the field (fig. 26, *h*). After a time, when the body was still, the whole became indolently polymorphic and amœboid in shape, while the cilium shrunk up to a short process (fig. 26, *i*). They were often seen in twos and fours together in a flexible mother cell about the field of observation (fig. 25); and each individual measured 1-6000th of an inch for the diameter of the body and 5-6000ths of an inch for the cilium.

These bodies were numerous while the *Halisarca* was quite fresh—that is, on the first day of capture and for three or four days afterwards, when it disappeared, as vibrios and other monadine bodies announced coming decadence in the sponge.

While their appearance in this sponge in its fresh state, together with the presence of the ova considerably advanced, led me at first to think they might be the spermatozoa of the species, the bulbous inflation of the tail and its power of anchoring the body looked so monadine that, together with its unusual appearance, whether spermatozoon or monad, its publication may not be altogether useless. Having since seen the free ends of the ectodermal cells of a *Gastrula* become bulbous, this alone is only proof of their sarcodal, polymorphic composition.

I have stated that the specimen of *Halisarca Dujardinii* in which these bodies were *exclusively* observed was "as pregnant with ova as that of *Grantia compressa*, but not so far advanced;" that is to say, the ova were in that stage of development when the granular yelk is clearly seen investing the nucleus, nucleolus, and germinal vesicle, measuring about 7-6000ths of an inch in diameter, and still reptant; while in a specimen which came from the Isle of Man and was sent to me by Mr. T. Higgin of Liverpool, they measure 45-6000ths of an inch in diameter (nearly seven times as much), and thus are visible to the naked eye, having passed through the nuclear stage and become probably nearly ready for delivery.

Hence, as the largest specimens of *Gastrula* in *Grantia compressa*, which appear to be equally ready for exit, do not measure more than 15-6000ths of an inch in diameter, it would seem that there is a difference in size, if not in development, between the ovum of the siliceous and calcareous sponges, when sufficiently matured to leave the parent.

From this I almost question whether the ovum in the siliceous sponges does not leave the parent before it arrives at the *Gastrula* state—that is, in the state of the *Planula*, when the cavity of the endoderm does not communicate with the exterior, but when the ciliated cells of the ectoderm are sufficiently developed to give the ovum full power of locomotion. This, however, is for future observation to determine. One point is evident, viz. that in the siliceous sponges the spicules are plentifully developed before the ovum leaves the parent, which is not the case with the *Gastrula* in the calcareous sponges, so far as my observation extends.

Since the above was written, I have obtained specimens of *Grantia ciliata*, Johnston (*Sycandra*, H.), in the oviparous state, but have not been able to detect any thing like spermatozoa in them. Indeed, only in the instances above mentioned have I ever met with any thing like spermatozoa, although I have examined living sponges hundreds of times under the microscope. Still I am well aware, from long experience, that, among the lower organisms, the meeting with the spermatic element is a matter of chance rather than of certainty.

EXPLANATION OF PLATE X.

N.B.—All the figures in this Plate, from 1 to 16 inclusive, have been taken from a piece of *Esperia ægagropila*, Carter (*Halichondria ægagropila*, Johnston, Brit. Sponges, p. 119, and type specimen, Johnstonian collection, British Museum). They also have all been drawn to the scale of 1-12th to 1-6000th of an inch (with the exception of 13, *c*, and 16, *a*), in order that their relative sizes may be at once appreciated. Of course the finer lines are diagrammatic.

Fig. 1. Transparent, empty, distended globular cell: *a*, cell-wall; *b*, nucleus or cytoblast.

Fig. 2. Granuliferous nucleus or cytoblast (undistended?).

Fig. 3. Tricurvate spicule, full-grown.

Fig. 4. Mother cell of tricurvate spicule. The young tricurvates in plurality arranged parallel to each other in a bundle, as they are wont to be in natural development: *a*, cell-wall; *b*, nucleus; *c*, tricurvates.

Figs. 5 & 6. The same, but with some of the tricurvates reversed.

Fig. 7. The same, where the tricurvates cross each other at nearly right angles.

Fig. 8. The same as figs. 5 and 6, but at an earlier stage of development, therefore smaller.

Fig. 9. The same, and the smallest size recognized, being not more than 1-3000th of an inch in longest diameter.

Fig. 10. Bihamate spicule, full-grown.

Fig. 11. Mother cell of bihamate spicule, containing a single spicule: *a*, cell-wall; *b*, nucleus; *c*, bihamate.
Fig. 12. Inequianchorate spicule, full-grown: *a*, lateral view; *b*, front view.
Fig. 13. Mother cell of inequianchorate spicule at a very early stage of development, when the embryo spicule is in the *equi*anchorate form: *a*, cell-wall; *b*, spicule; *c*, the same amplified to show the *equi*anchorate or hooked ends.
Fig. 14. The same, where two individuals were in one cell.
Fig. 15. The same, where the cell has become polymorphic.
Fig. 16. The same, in a more advanced stage, where the spicule has become *inequi*anchorate: *a*, cell-wall; *b*, nucleus; *c*, inequianchorate spicule; *d*, the same, amplified to show the nucleus and granuliferous state of the cell-wall.
Fig. 17. *Microciona atrosanguinea*, Bk., spermatozoid-looking bodies in. Scale 1-24th to 1-6000th of an inch.
Fig. 18. The same, single one. Scale 1-12th to 1-6000th of an inch: *a*, head and granule; *b*, cilium.
Fig. 19. The same; group of four together. Same scale.
Fig. 20. The same. Scale of 1-4th to 1-6000th of an inch: *a*, head; *b*, granule; *c*, cilium.
Fig. 21. *Grantia compressa*; spermatozoid-looking bodies. Scale 1-24th to 1-6000th of an inch.
Fig. 22. The same, single one. Scale 1-6th to 1-6000th of an inch.
Fig. 23. The same. Scale 1-3rd to 1-6000th of an inch.
Fig. 24. *Halisarca Dujardinii*; spermatozoid (?) bodies. Scale 1-24th to 1-6000th of an inch.
Fig. 25. The same; group of four in a cell. Same scale.
Fig. 26. The same: *a*, individual attached to a group of sponge-cells by the *head*; *b*, rim; *c*, granule; *d*, cilium; *e*, the same, showing inflation of the rim opposite the cilium; *f*, lateral view of head; *g*, cap-like projection of centre of disk; *h*, individual attached to a group of sponge-cells by the *end of the cilium*, rendered bulbous under polymorphism; *i*, polymorphic state with shrunk-up cilium.

XIV.—*On some Species of* Amphithoë *and* Sunamphithoë. By the Rev. THOMAS R. R. STEBBING, M.A.

[Plates XI. & XII.]

IT will be seen by the following descriptions how very closely allied these two genera are to one another, and how closely allied also are certain species within the genera. It will be seen likewise that some readjustment is probably necessary.

A new species is added to the genus *Amphithoë*, and one which appears to have been partially, but only partially, described before as a species of *Amphithoë* is found to have a hooked telson, which will transfer it to the genus *Sunamphithoë*; but this species, not content with a single hook to